DOCUMENT RESUME

ED 180 358 HE 012 094

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TITLE Student Enrollment Forecasting Techniques for Higher Education.
INSTITUTION West Virginia Univ., Morgantown.
PUB DATE Oct 79
NOTE 33p.: Paper presented at the Annual Conference of the Southern Association for Institutional Research (Orlando, FL, October 1979)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS College Faculty: *College Planning: Colleges: Decision Making: Declining Enrollment: Educational Economics: *Enrollment Projections: Futures (of Society): Higher Education: Institutional Research: Long Range Planning: Needs Assessment: *Prediction: *Research Methodology: Statistical Analysis: Universities

ABSTRACT

Various techniques used by state agencies, secondary schools, community colleges, and large universities to forecast enrollments are described and guidelines for constructing forecasting procedures are outlined. The forecasting techniques are divided into three categories: (1) quantitative techniques based on historical data that attempt curve fitting: (2) causal models that incorporate historical data and rely on a relationship between enrollments and other parameters, or techniques incorporating subjective judgment rather than quantitative measures: and (3) qualitative techniques utilizing surveys to determine potential students and to modify or suggest adjustments to previously developed forecasting techniques. The selection of an appropriate forecast methodology is dependent on both the resources available and the characteristics of the institutions. The statistical methodology involved in each forecasting technique is detailed. It is suggested that changes in faculty supply and demand, facility needs, and educational economics have increased the importance of accurate enrollment projections. Through accurate forecasting input for both long- and short-range planning can be compiled. (Author/SF)

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West Virginia University

Office of Institutional Research

STUDENT ENROLLMENT FORECASTING TECHNIQUES FOR HIGHER EDUCATION

ED180358

PRESENTED AT:

Annual Conference of the Southern Association for Institutional Research - Orlando, Florida, 1979

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ABSTRACT

This paper will attempt to overview the various techniques used to forecast enrollments in post-secondary schools. For the purpose of this review, the forecasting techniques will be categorized into three control classes:

(1) Quantitative: Techniques based on historical data and that attempt curve fitting.

(2) Causal Models: Techniques incorporating historical data and which rely on some relationship between enrollments and other parameters (e.g., high school graduates, live births); also, techniques incorporating subjective judgment rather than quantitative measures.

(3) Qualitative: Techniques utilizing surveys to determine potential students and used to modify or to suggest adjustments to previously developed forecasting techniques.

These three categories subsume many different techniques, with the appropriateness of each contigent upon the situation under study. Throughout the review forecasting techniques will be matched with situations and, wherever possible, illustrative examples will be provided showing the mathematical equations used; the data requirements; and specific assumptions.

INTRODUCTION

Yesterday's increasing enrollments and today's decreasing enrollments have brought about changes in faculty supply and demand, facility needs, and the dollars needed and avaiable in any university system. Educational planning to a considerable extent is based around what present enrollments are and what they will be in the future. The purpose of this paper is to examine different enrollment projection methodologies and to provide guidelines for constructing forecasting procedures.

PURPOSE AND CONSIDERATIONS

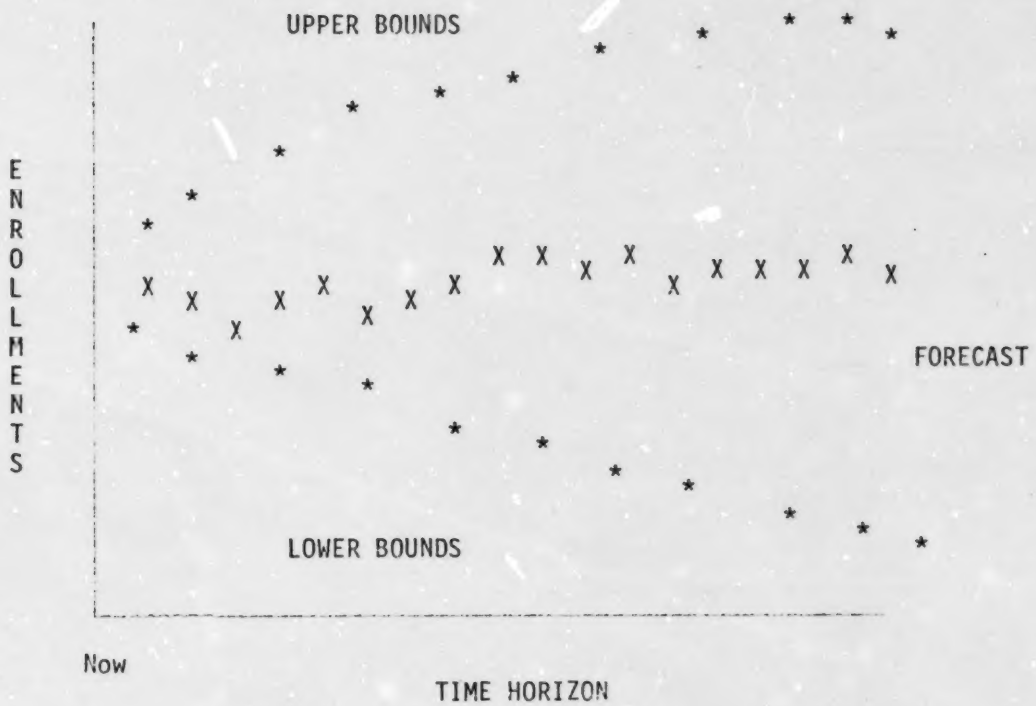
The purpose of forecasting is to reduce the risk in decision making. Within this framework, forecasting provides input for both short and for long range planning decisions.

The first concern of any forecast is accuracy. Few would dispute that as one moves from short-range to long-range forecasts, one becomes less certain about accuracy. Figure 1 presents a schematic representation of this phenomenon. It is not difficult to see why this is true in higher education with the changes in student demand, costs of attendance, influx of adult and minority students, and so forth.

In developing a forecast the following time elements should be considered: (1) the forecasting period, (2) the forecasting horizon, and (3) the forecasting interval. The forecasting period is the basic unit of time for which forecasts are made. The forecasting horizon is the number of periods in the future covered by the forecast and the forecasting interval is the forecasting frequency (i.e., how often new

forecasts are prepared). Often, the forecasting interval is the same as the forecasting period. In this way, forecasts are revised each period using the most recent period's demand and other current information as the basis for revision.

FIGURE 1



As an example, the enrollment forecasts at most universities are performed on an annual basis (the forecasting interval) for periods of one year intervals (the forecasting interval), upon which the forecasts are carried out eighteen years into the future (the forecasting horizon).

One last consideration before attempting to forecast student enrollment is the data that will be used. First off, is the data

available and secondly what are the assumptions concerning the data.

Data about such things as the supply of openings, costs of attendance, and so forth probably are best collected at the institutional level. These data then can be aggregated to any higher level as appropriate. Data about such things as recent higher education participation patterns of high school graduate probably should be collected from or through the high schools.

The important thing to note is that all the data required to support the various techniques probably are not readily available in one neat package. Some data may come from institutions in the state, some from the U.S. Census Bureau, some from the state department of education, and some from other sources. It also may be necessary to use surrogate data; for example, a five-year-old report of a survey of high school seniors might be the only source for a rough estimate for one of the paramenters in a technique chosen as part of a forecasting procedure. It may even be appropriate to rely on the subjective judgement of an expert to fill in some of the gaps in a historical time series.

At the outset, all assumptions must be established and considered. If any one or a combination of these assumptions should prove to be false, the validity of the projections which follow will be questionable. A list of assumptions used in enrollment projections for West Virginia University may be found in Appendix 1. It may be argued that deviations from any of the assumptions may compensate for one another. For example, unexpected tuition and fee increases may be offset by unexpected expansion in available student financing. But combinations of deviations might also operate to bring large or smaller enrollments and projections.

ALTERNATIVE FORECASTING METHODS

Forecasting methods can be broadly classified into three categories: (1) qualitative (or intuitive), (2) curve fitting and (3) causal models. The selection of a methodology to use for projections is most likely dependent upon the resources available to gather and to analyze the data; and, more importantly, upon how closely the assumptions required by the technique correspond to the actual situation under study.

QUALITATIVE (INTUITIVE) PROCEDURES. Qualitative procedures involve subjective estimation and are primarily used when data are scarce or unavailable, as for example, at a newly created institution opening its doors for the first time to students. They use human judgment and rating schemes to turn qualitative information into quantitative estimates. Techniques range from the use of individual expert opinion and simple opinion polls, to the use of expert panels and the Delphi technique to secure a consensus from a group of experts. The panel approach is designed to effect a desirable interaction among several experts by bringing them into personal contact with one another. This technique is based on the assumption that several experts can arrive at a better forecast than one person. There is no secrecy and communication is encouraged. The forecasts are sometimes influenced by social factors, and may not reflect a true consensus. One disadvantage to this approach is that it provides the opportunity for more forceful personalities present to dictate the group opinion.

The Delphi technique is an organized, systematic method to obtain a consensus of expert opinion and avoids many shortcomings of the panel

and polling approaches. Some of the undesirable features of group or committee discussions are avoided by the use of questionnaires. The technique is carried out in such a manner that many of the advantages of expert interaction are still achieved.

In the Delphi approach direct debate is replaced by a carefully designed program of sequential interrogations, usually conducted by questionnaires, with controlled feedback. Without allowing personal or fact-to-face contact, the experts are provided with iterative controlled feedback to raise questions where divergent opinions exist and to identifiy areas of reasonable agreement. However, again in the opinions are only as good as the experts that have been selected. In all these procedures, the experts' responses may be based on objective as well as subjective data. As is often the case, the variable being forecasted and be assessed in terms of a subjective probability distribution. A discussion of the baises and difficulites associated with probabilistic predictions is presented in Moskowitz, Schaefer, and Borcherding (1976).

CURVE FITTING MODELS

The logic behind all curve fitting models is clearly explicated and the procedure is strictly mathematical. The techniques rely solely on historical data and the assumption that the process is stable, and use this knowledge to extrapolate the process into the future.

Curve fitting models are based on the assumption that existing patterns will continue into the future. This assumption is more likely to be correct over the short term than it is over the long term, and for this reason these techniques provide us with reasonably accurate

forecasts for the immediate future but do quite poorly further into the future (unless the data patterns are extremely stable).

For this same reason, these techniques ordinarily cannot predict when the rate of growth in a trend will change significantly. Some examples of curve fitting techniques in order of increasing sophistication and complexity include (1) moving average, (2) exponential smoothing, and (3) polynomial models.

(1) Moving average. In using the moving average, one simply employs the most recent observations to calculate a simple (or weighted) average, to forecast the next period. Suppose, for example, that we wished to obtain from Table 1 a forecast for WVU's freshmen enrollment for 1979 using a three-period moving average. By simply taking the last three years of data from the table the forecast would be as such:

TABLE 1
WVU Freshment Headcount Enrollment By Year

YEAR/	ENROLLMENT
1978	5200
1977	5100
1976	5000
1975	4900
1974	4800
1973	4700
1972	4600
1971	4500
1970	4400

$$\text{Forecast for 1979} = \frac{5200 + 5100 + 5000}{3}$$

$$= 1/3\ (5200) + 1/3\ (5100) + 1/3\ (5000)$$

$$= 5100$$

What we have effectively done in making the forecast is to give equal weight to the most recent three periods of data and zero weight

to the rest of the older data. Note that the sum of the weights should equal 1.

We could also make forecasts beyond the immediate forthcoming period. For example, to forecast 1980's enrollment we would simply incorporate the 1979 predicted (5100) with the 1978 and 1977 actuals to determine a prediction.

The choice of the number of periods to include in moving average is a measure of the relative importance we attach to old versus current data. Clearly, if we feel the process is stable or is changing slowly, we should use a large moving average (sample) to filter out the noise. Conversely, if we feel that the process is unstable or is changing rapidly, we should adopt a small moving average to keep pace with the changing process. From a statistical standpoint, what we are actually doing is trading off bias against precision. For example, if a process is known to be stable, the larger sample we take, the more accurate the estimate of expected demand. This is because the sampling distribution of the mean gets tighter as the sample size is increased. Thus, in forecasting with the moving average, the accuracy of the forecast (which is composed of bias and precision) depends on the number of observations, and the optimum number of observations depends on the rate of change in the process.

The moving average concept can be extended by assigning variable weights to older data, where the weights decrease with increasing age of data. Using the last example, we might assign 5/8, 2/8 and 1/8 to the most recent, next most recent, and oldest data, respectively. In this case, our forecast for WVU freshmen in 1979 would be

forecast for 1979 = 5/8 (5200) + 2/8 (5100) + 1/8 (5000)

= 5150 10

We could further extend this notion to using a moving average that assigns positive weights to all past data, such that the weights are monotonically decreasing with increasing age of data. This assures that all data are used in the forecast, but the older the data, the less its influence.

(2) Exponential Smoothing. A moving average has the following shortcomings which limit its attractiveness as a forecasting technique: (A) weights of all the data in the sample are usually given equal weight rather than giving the more recent data greater weight, (B) only part of all past data are used in making the forecast, and (C) it is computationally onerous in the sense that a good deal of data must be retained from period to period to make the forecast. If our moving-average size is 300, this could be a bit computationally inconvenient, even with a large computer.

Exponential smoothing circumvents these shortcomings. In exponential smoothing we assign weights to past data, such that the weights monotonically decrease with its increasing age. This is in keeping with the premise that in a changing process, recent data are more valid than older data. Moreover, with exponential smoothing we need only (A) the current period's forecast, (B) a smoothing constant value, and (C) the actual current period's datum to make a forecast into the future, thus eliminating the need for storing large amounts of past data. As averaging is involved, however, it shares the same deficiencies of not being able to predict large expansion (or contraction) of enrollments.

Simple exponential smoothing forecasts are made as follows: the new forecast is equal to the last forecast plus a fraction of the

difference between the last datum and the last forecast. The fraction α is called the smoothing constant and varies from 0 to 1. Symbolically,

$$\bar{F}_t = \bar{F}_{t-1} + \alpha (D_{t-1} - \bar{F}_{t-1})$$

where $\bar{F}_t$ = new forecast (e.g., for 1979)

$\bar{F}_{t-1}$ = last forecast (e.g., 1978)

α = smoothing constant

D_{t-1} = last datum (e.g., actuals for 1978)

Alternatively stated, our new forecast is the last forecast plus a correction factor that is proportional to the error in our last forecast. To illustrate the use of this simple model, let us apply the formula to the data in Table 1, initially using $\alpha = 0.2$ and $\bar{F}_0 = 5200$.

$$\bar{F}_{(1980)} = (0.2)\ (5100) + (0.8)\ (5200)$$
$$= 5180$$

The rationale for choosing α and the effect of the value of α on the forecast is simple. Real forecasting systems require a considerable degree of subjectivity. With exponential smoothing, we exercise judgment in selecting α and an initial forecast. If we believe that the process is stable, we make α small. In this way we increase the precision of our forecast without worrying too much about bias. If, however, we believe that the process is changing, we would want a larger α to give us a quicker response.

Higher-order smoothing procedures also are available and typically are more responsive to change than the first-order smoothing procedure. they require the same basic assumptions, however, and they will not overcome the fundamental shortcoming of the procedure. Readers interested in the details of higher-order smoothing procedures can

consult Brown (1963, Chapter IX).

(3) Polynomial Models. Moving averages and exponential smoothing methods require that enrollments remain constant. Contingent upon which polynomial model is chosen, this requirement can be cicumvented. If the long-range enrollment approximates a straight line, the mathematical model is as such:

$$\overline{Y}_p = a + bX$$

where $\overline{Y}_p$ = predicted enrollment for a selected year

a = intercept (unknown)

b = slope (unknown)

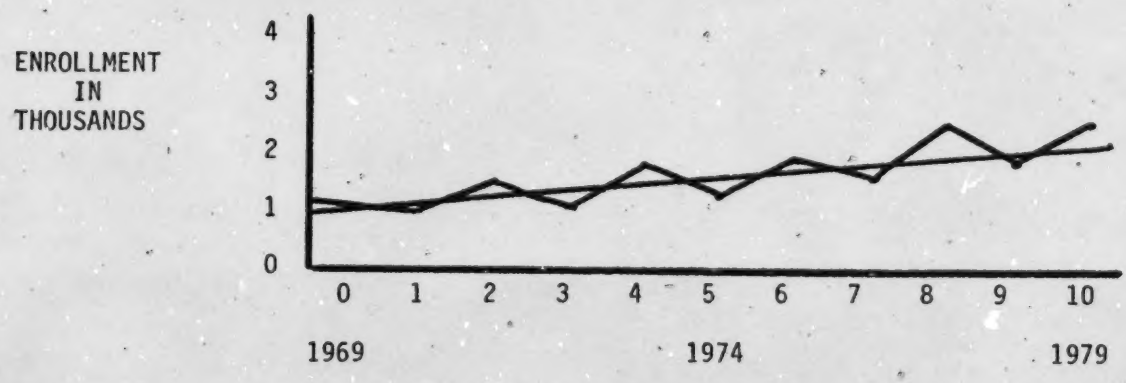
X = time in years

Generally, there are three methods that can be used to solve the linear-trend equation; namely, the freehand method, the semiaverage method and the method of least squares.

The freehand method may be used if an approximate linear-trend is deemed satisfactory. Using a ruler, the first step is to draw a straight line through the data. It should be drawn through the middle of the plots as shown in Figure 2.

FIGURE 2

EXHIBIT OF A LINEAR FREEHAND TREND LINE



Next, the beginning year 1969 is designated the origin, or zero year. The years 1970 through 1979 are coded 1 through 10 respectively.

The line intercepts the Y- axis in 1969 (zero year) at 1,000, therefore a is 1,000. Note that the straight line representing the path of enrollment increased from 1,000 in 1969 to 2,200 in 1979. Enrollment during the ten year period increased 1,200 or an average of 120 students per year. Therefore, b = 120.

The semiaverage method is seldom used and will not be dealt with in this paper except to note, as the method implies, averages are used for the two halves of the series in predicting the trend line. The *a* and *b* parameters are arrived at the same way as for the Freehand method.

The least squares method of arriving at the straight line gives the "best fitting" line.

Two equations are solved simultaneously to determine the equation. They are:

$$\text{Equation I:} \quad EY = Na + bEX$$

$$\text{II:} \quad EXY = aEX + bEX^2$$

Using the data in Table 2 the equation may be solved as such:

TABLE 2
EXHIBIT OF THE COMPUTATIONS FOR THE LEAST SQUARES METHOD OF DETERMINING THE TREND EQUATIONS

Year	Enrollment (in thousands)	X	XY	X^2
1970	7	0	0	0
1971	10	1	10	1
1972	9	2	18	4
1973	11	3	33	9
1974	13	4	52	16
TOTAL	50	10	113	30

$$50 = 5a + 10b$$
$$113 = 10a + 30\ b$$

Equation I was multiplied by 10, and Equation II by 5 to eliminate a:

$$500 = 50a + 100b$$

$$565 = 50a + 150b$$

Subtracting Equation II from Equation I:

$$\text{I:}\quad 500 = 50a + 100\ b$$

$$\text{II:}\quad -565 = -50a + -150b$$

$$-65 =$$

$$b = 1.3$$

This b value can be substituted in the original Equation I, or Equation II to solve for a

$$\text{Equation I:}\quad 50 = 5a + 10b$$

$$50 = 5a + 10(1.3)$$

$$a = 7.4$$

The Equation is:

$$\overline{Y}_p = 7.4 + 1.3X$$

A straight line trend is used when it is believed that the time-series data are increasing (or decreasing) by equal amounts, on the average, from one time period to another.

The straight-line equation $\overline{Y}_p = a + bX$ is called a first-degree equation. It is used when data have, in general, only one direction. Other series can be described using a trend equation other than a first-degree equation. For example, a second degree equation has three constants, a, b, and c,; the line has two directions. Three equations, instead of two, are solved simultaneously to determine the constants the equation for the second-degree polynomial is:

$$\overline{Y}_p = a + bx + cx^2$$

Also, in considering straight-line equations, it should be noted that data which increase (or decrease) by increasing amounts over time appear curvilinear. In this case the trend equation can be computed using the logarithms of the data and the least squares method.

One general problem with polynomial model forecasting techniques is that one usually is not certain ahead of time which specific polynomial form should be used. It could be linear (that is, first order), quadratic (that is, second order), or some more complex form. There is also the important question whether it is appropriate to assume that the trend or pattern of past enrollments (assuming that it can be fit by some polynomial model) will continue in the future. If, as in many states in the early 1970's, this is not the case, polynomial models are not entirely appropriate.

Throughout the first section of this paper various methods of curve-fitting models have been provided. The critical question that remains for enrollment forecasting practitioners in which, if any, of these and other techniques should be used in actual practice. The answer to this question will depend in large part on the nature of the enrollment trends with the state. If they are unstable, then it would probably be best to avoid all of the curve-fitting techniques. Naturally, if one is quite certain about the nature of the instability and therefore can calculate approprate adjustments, one of the polynomial models may be acceptable.

CASUSAL MODELS. Causal Models attempt to define relationships among system elements. As with times-series analysis, past data are important to causal models. Thus, when historial data are available and enough analysis has been performed to spell out explicity the relationships between the factor to be forecast and other factors, the forecaster often constructs a causal model.

A causal mode is the most sophisticated kind of forecasting tool. It expresses mathematically the relevant causal relationships. It is in essence, a mathematical description of the underlying process. Hence, the purpose of a causal model is often not merely to predict, but also or rather to explain the process.

Causal models are by far the best for predicting turning points and for preparing long-range forecasts. The two examples that will be discussed are regression and modified cohort-survival.

Cohort-survival Ratio

The cohort-survival ratio uses the average ratio of student from class to successive class. The average class to class ratios are then multiplied by current class enrollments to obtain future enrollments. For example, if 12 students are sophomores this year and 15 students were freshmen last year, then the survival ratio from freshmen to sophomore is .80. The survival ratio is averaged over a period from five to ten years.

Enrollments from this method are obtained as follows:

$$E_n = E_{n-1}(R_{n-1 \text{ to } n})$$

where: E_n = Enrollment in class n at time t

E_{n-1} = Enrollment in class n-1 at time t-1

$R_{n-1 \text{ to } n}$ = The average survival ratio of students from class n-1 to n over m years

To illustrate this technique, the following example is presented:

College Anytown Enrollment
Class Freshmen-Junior

	H.S. Grad.	Freshmen	Sophomore
1970-71	50	60	55
1971-72	45	52	62
1972-73	30	45	52
1973-74	30	28	47
1974-75	25	27	35
1975-76	23	24	30

Survival Ratio Calculation

	H.S. Grad.	R_{1st}	Freshmen	R	Sophomore	R
1970-71	50		60			
		1.04				
1971-72	45		52			
		1.00				
1972-73	30		45			
		.933				
1973-74	30		28			
		.90				
1974-75	25		27			
		.96				
1975-76			24			

R_1 = Freshmen enrollment 1971-72 ÷ H.S. Graduate enrollment 1970-71 or

52 ÷ 50 = 1.04

$$\bar{R}_{1st} = \frac{R_1 + R_2 + R_3 + R_4 + R_5}{5} = \frac{1.04 + 1.00 + .933 + .90 + .96}{5} = .967$$

This procedure is used to calculate 4 survival ratios between the 4 classes. The average survival ratios are then multiplied by current enrollments to arrive at subsequent enrollments. In this example, next year's freshmen enrollment is estimated to be .967 x 23 or 22.

Several problems exist with this method. First, the method assumes taht the trend present five years ago will have the same influence as the trend over the last few years. Secondly, the method to arrive at High School Graduate enrollments has not been presented. The estimated future High School Graduate enrollments will be treated in a separate section; however, the first problem will be considered in the next section. In Institutions where enrollments are fairly constant from year to year, this technique will produce estimates similar to other techniques.

Weighted Cohort-Survival Ratios

The techniques to weight the cohort-survival ratios obtained in the preceding section is very straightforward. However, the weights applied to each ratio are somewhat arbitrary and may unduly consider the most recent events.

The weighting proposed for the preceding example would be as follows:

$$\bar{R}_1 = \frac{R_1 \times 1 + R_2 \times 2 + R_3 \times 3 + R_4 \times 4 + R_5 \times 5}{15}$$

$$\bar{R}_1 = \frac{1.04 \times 1 + 1.00 \times 2 + 9.33 \times 3 + .90 \times 4 + .96 \times 5}{15} = .949$$

The most recent ratio is weighted five times as heavy as the ratio calculated five years previously. The influence of more recent events or socio-economic conditions will be considered five times heavier than the conditions noted five years ago. A slight variation from this techniques is to consider the last projection in the next projection by deleting the oldest ratio and adding the ratio used in the projection. Hence each year of historical data is weighted differently for each projection. For example, if six years of enrollments are used (five survival ratios), then the weighting for each year of projection is as follows:

Year	Weighting Between Years
1	1:1:1:1:1
2	1:6:6:6:6
3	1:1.8:6:6:6
4	1:1.8:2.5:3.2:3.2
5	1:1.8:2.5:2.9:3.2

Regession Analysis

The regression analysis approach uses the same data as the cohort-survival techniques. Next year's sophomore students are predicted from this year's junior students. Twelve equations of the form $y = a + b\,x$ are derived through least-squares techniques.

The derived equations are as follows:

$$E_n = a + b\,(E_{n-1})$$

where E_n = Enrollment in class n in year t

a = The y intercept of the line defining the relationship of the enrollment of class n in year t with enrollment of grade n-1 in year t-1.

b = The slope of the line defining the relationship of the enrollment of class n in year t with enrollment of grade n-1 in year t-1.

E_{n-1} = Enrollment in class n-1 in year t-1

The use of regression requires several additional assumptions over the cohort-survival method. The model which is presented is linear, indicating the line which best fits the relationship between independent and dependent variables is a straight line. If a curvilinear model is more appropriate, then projections made form the linear model will be in error. However, over a short period of time and few number of data points, curvilinearity should not be a problem since the relationship can reasonably be approximated by a straight line.

Additional assumptions regarding the technique will not be discussed here; however, the interested reader should consult the literature prior to using this technique to establish confidence intervals.

Other Methodolgies

Variations in the previously discussed methods as well as consideration of additional methods may be appropriate in differing local situations. A combination of regression and survival ratio technique is one possibility. Instead of averaging the survival ratios over time, a regression analysis of the survival ratios is used. A trend in the ratios, if one exists, can be determined as well as establishing upper and lower limits on future ratios.

In institutions undergoing substantial growth, especially because of land development, a dwelling-unit yield multiplier method might be considered. The average number of pupils yielded by type of housing such as single family dwellings to apartment houses is considered. The overall technique is an extension of land-use surveys applied to enrollment projections. Since larger communites experiencing growth will usually have conducted surveys to determine future police and fire

protection needs as well as planning streets, the required information for such a technique is available. Also, needed information on construction started, building permits issued, and the housing seriously being considered is usually available.

Dwelling unit multipliers are calculated by defining and counting the dwelling unit types. Secondly, the number of students enrolled in public school and living in a particular type of unit must be known. Periodic surveys are needed to validate or update multipliers as the community or areas within the community change. For example, it may be found that single family detached units produces .80 children of secondary school age. Low-rise apartments produce .10 children of elementary age per residential unit. Hence if 100 new houses were going to be built next year, in addition to four 50 unit low-rise apartments, then the following increase in enrollment would be anticipated:

100 units x .80 secondary children/unit =	80 children
4 x 50 units x .10 elementary children/unit =	20 children
	100 children

The multipliers usually require field surveys to be done. However, they serve as a valuable check on other techniques as well as being very responsive to communities which are changing.

Other methodologies such as calculating student populations as a percent of state, county, or local populations are also approaches which can be used to project enrollments. The availability of recent data is definitely a deciding factor in using such an approach, especially if census data is used.

Variations in any of the techniques might be considered if the

user has reason, hopefully empirically established, to believe that the variation will improve the accuracy of the projection. It is important to remember that regardless of the technique, if factors upon which the method used suddenly change, the previous estimations will probably be inaccurate. The projections are based upon past trends and only to the extent these trends continue into the future will the estimates be usable.

SUMMARY

In identifying which type of forecasting technique to use one should first consider what the forecasting problem is.

To define the forecasting problem, we must begin with the decision problem (or how is the forecast to be used). The information from the forecasting process is to be used as input to improve the decision-making process. A study of the decision problem should help answer such questions as:

1) What are we forecasting?
2) What form should the forecast take?
3) What are the time elements?
4) What is the desired accuracy of the forecast?

There are several other additional factors that should also be considered in defining the forecasting problem. One concerns the behavior of the process being generated. If the process is stable, the forecasting model may be quite different from that required when the process is unstable. A stable process would make considerable use of historical data (assuming that it is available) to predict the future, while an unstable process would more heavily rely on subjective estimates, since the process is always changing and hence historical data are irrelevant.

Another important factor is data availability; also its quantity, accuracy, timeliness, and representativeness. The computational limitations imposed on the forecasting system is also an important consideration and must be defined. If only a few variables are forecasted infrequently, more elaborate analysis procedures are possible than if a large number must be analyzed often.

In general a causal model is better than a curve-fitting type, however, if strong relationships between variables cannot be identified than a forecaster has little choice. Ideally the personnel doing the forecast should be the same year after year, as the forecasting technique should be continuously refined being an ongoing process from year-to-year.

If the forecast is being done for the first time, it is a good idea to try out the process using past year's data and predicting an actual year's enrollment to determine what kind of 'hit rate' you can expect. Also, the gaming approach can be used as for example you may want to determine what the enrollments would be if there is going to be a change in tuition, or if the entrance requirements were changed, etc.

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APPENDIX 1

4.0 Student Body: (See the detailed Forecast of Enrollment in Appendix A)

4.1 Anticipated Enrollment Patterns--Morgantown Campus--Enrollment patterns on the Morgantown campus will develop as follows:

4.1.1 Foundation Level--The University will continue to offer individualized attention to students needing specific kinds of help, especially in communications skills. During the planning period, approximately 230 FTE students per semester will be enrolled in programs of this nature.

4.1.2 Undergraduate--Overall, undergraduate enrollment will increase through 1980-81 when it will peak at 12,860 and then decline at about 1.3% per year through the remainder of the planning period. First-time freshman enrollment is expected to decrease at an average rate of 2% per year until 1985-86 when the projected first-time freshman enrollment will be 2680. Total Lower Division enrollment will decrease at an average rate of 1.4% per year through 1985-86 to a total of 6300. Enrollment at the Upper Division levels will increase during the planning period to 5715 at an average rate of .7% per year because of additional transfers and higher retention rates among Lower Division enrollees.

4.1.3 Graduate School--Total enrollment in the Graduate School will increase from 3752 in 1975 to 4925 in 1980 when it will equal approximately 33% of the total enrollment on the Morgantown campuses. The enrollment of beginning graduate students, i.e., those who have completed less than 36 hours, will increase by 31% over the 1975-76 level, reaching a total of 3695 by 1980-81. Advanced graduate enrollment will also increase by 31% during the same period to a total of 1230 in 1980-81. It is expected that these figures will remain constant over the remainder of the planning period.

4.1.4 Unclassified--Unclassified students are those, both pre- and post-baccalaureate, who are enrolled in credit-granting courses, but who

are either not matriculating in a degree program or have not yet had their academic credentials evaluated prior to being formally admitted to a degree program. Because the University is improving the speed with which it evaluates academic credentials, it is anticipated that the number of unclassified students will decline about 48% during the planning period from a total of 139 in 1975-76 to about 72 in 1985-86.

4.1.5 Law--Continuing the expansion permitted by the opening of the new building, enrollment in the College of Law will increase to 395 students in 1976-77. Enrollment in the College will remain at that level through 1985-86. Even with the expansion in facilities, student demand will continue to exceed the number of student stations available.

4.1.6 Health Sciences--The student demand in all of the health science areas will continue to exceed the available student stations. Any increase in enrollment in these areas will be deferred until the completion of additional physical facilities anticipated for summer, 1980. At that time the total enrollment in each school will begin to increase as follows: Medicine (from 337 to 496) and Nursing (from 202 to 250). Dentistry will remain stable at 245 during the planning period, as will the School of Pharmacy (205) and the Dental Hygiene Program (100). Enrollment in Medical Technology (59) and Physical Therapy (32) will also remain stable. Since the health sciences are undergoing regular change, it is anticipated that at least one new program will be started at the Medical Center during the planning period. An allowance of at least 15 student stations will be set aside for this contingency. The number of post M.D. students, i.e., interns and residents on the house staff at University Hospital, will increase from 173 to 220 during the planning period.

4.1.7 Out-of-State--At the undergraduate level only, out-of-state enrollment will continue at the present ratio of about 30-35% of the total undergraduate population. Because of the demand for the limited number of student stations in the College of Law and the Schools of Dentistry, Medicine, Nursing, and Pharmacy, preference will continue to be given to qualified in-state applicants.

4.1.8 Overall Enrollment on the Morgantown Campus--Total enrollment, excluding summer programs, will increase from 18,075 in 1975-76 to approximately 19,600 in 1980-81 followed by a decrease to approximately 18,850 in 1985-86. By 1980-81 post-baccalaureate enrollment will reach about 30% of the total enrollment and remain at that level through the remainder of the planning period.

4.1.9 Summer Programs--Student enrollment in summer programs will remain stable at about 6300 for the planning period with a modest shift from persons taking graduate and undergraduate work toward a degree to persons engaging in in-service conferences and special-topic workshops.

4.2 Anticipated Enrollment Patterns--Non-Base Campus and CEU Students--Enrollment patterns in other programs of the University will develop as follows:

4.2.1 Undergraduate Resident Credit Non-Base Campus Program--This program is currently limited to the offering of selected courses at the Kennedy Youth Center, Telelecture, and a few directed-studies courses. Fall semester enrollment for 1975-76 was 65. It is expected that undergraduate off-campus enrollment will continue at this level during the planning period.

4.2.2 Graduate Resident Credit Non-Base Campus Program--This program is restricted, essentially, to 33 northern counties. However, with the continued development of the five off-campus graduate centers (West Liberty, Keyser,

Shepherdstown, Jackson's Mill, and Parkersburg) and the expansion of degree programs available at these centers, enrollments are expected to increase from the fall semester, 1975 enrollment of 1933 to 3000 per semester by 1985.

4.2.3 Graduate Resident Credit Non-Base Campus Summer Program--This program normally serves the unique needs of part-time off-campus students through workshops, directed studies, and internship programs. The 1975 enrollment of 800 is expected to remain constant through 1985.

4.2.4 Potomac State College--Enrollment will increase from 943 in 1975-76 to 1060 in 1985 in response to a good mix of technical programs and improved articulation with WVU through the transfer program.

4.2.5 Continuing Education Students (CEU Programs)--It is anticipated that there will be an increase in the total WVU CEU Program participation from 10,615 persons in 1975 to 25,000 in 1985.

The number of participants in University sponsored noncredit conferences, workshops, seminars, etc., will increase from 10,500 in 1975-76 to 13,000 in 1985-86.

4.2.6 Cooperative Extension Service Programs--The groups that work with the Cooperative Extension Service can be separated into four major areas: (1) Agriculture and Natural Resources, (2) Home Economics and Family Living, (3) 4-H Youth, and (4) Rural Community Resource Development.

The demand for agricultural products will accelerate during the next ten years. With production and marketing technology changing rapidly, subject matter problems with producers will become more complex and more service time will be requested from the Extension staff.

Home economics and family living programs now reach about 13,000 participants in organized clubs. In addition, approximately 10,000 non-members carry on a variety of activities. Special emphasis in program expansion will be placed on reaching young homemakers, special interest groups, the elderly, working women, and professionals. Limited-income families are another area of concern. During the past five years, the special nutrition program has reached 20,000 families representing 90,000 limited-income persons. It is expected that an additional 25,000 families will be reached in this program by 1985.

The 4-H Youth Program now reaches a total of 82,000 young people. Of this number, 30,000 belong to organized 4-H Clubs; 13,500 participate in 4-H Special Interest Groups; 8,000 are involved in a special 4-H Nutrition Program, and 30,500 participated in 4-H Educational TV Programs. An extensive 4-H Camping Program embraces 18,500 young people in County 4-H Camps, Area Science Camps, Opportunity Camps, Area Self-Understanding Camps, and Statewide Camps at Jackson's Mill. The total 4-H Youth Program is projected to expand at an annual rate of about 5% through 1985.

Rural community resource development programs are growing in number because of the growing interest in general improvement and beautification and in services and facilities. There is an accelerating demand for training and information by public officials as they are thrust into assuming developmental and leadership roles by legislative and citizen expectations. These changes will require additional Extension Service involvement.

4.3 Characteristics of the Student Body:

4.3.1 Academic Ability of Entrants--The University expects a continuation of its historical record of attracting students of better than average

ability (i.e., having high ACT scores and high school grade point averages of B or better) as compared to other state universities and land-grant colleges.

4.3.2 Tendency to "Stop-Out"--The University expects that a relatively small but significant number of students will discontinue their University education for short periods of time, later to return to the University. Such "stop-outs" will probably increase in number.

Composition--New opportunities for women and minorities will cause shifts in the sexual, racial, national origin, and age distributions of the student body which will be reflected in changes in academic programs and student services. In addition, the average age of the members of the student body will increase during the planning period reflecting the presence of persons pursuing education for the purpose of keeping up with changes in their career field and/or desiring to change their careers. There will be an increased number of persons on campus working at the post doctoral level.

4.3.4 Need for Financial Assistance--The proportion of WVU undergraduate students requiring assistance to finance their educations will increase from 40% in 1974-75 to 70% in 1985-86. For graduate students, the proportion will change from 22% to 44%.

4.3.5 Term of Residence--Because of involvement in part-time work and because of changes in career planning, undergraduates will continue to require an average of nine or more semesters in residence to complete their degrees.